# MONTHLY WEATHER REVIEW.

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## INTRODUCTION.

This REVIEW is based on reports for January, 1893, from 2,785 regular and voluntary observers. These reports are classified as follows: 164 reports from Weather Bureau stations; 47 reports from United States Army post surgeons; 2,010 monthly reports from state weather service and voluntary observers; 220 reports through the Central Pacific Railway Company; 319 marine reports through the co-operation of the Hydrographic Office, Navy Department; 25 reports from Canadian stations; marine reports through the "New York Herald Weather Service"; monthly reports from local services established in all states and territories; and international simultaneous observations. Trustworthy newspaper extracts and special reports have also been used.

## CHARACTERISTICS OF THE WEATHER FOR JANUARY, 1893.

The month was characterized by exceptionally low temperature and heavy snowfall in the Middle and Southeastern States. Navigation in the rivers of the middle and northern districts was suspended on account of ice, and streams in northern parts of the Gulf and south Atlantic states were frozen. During a great part of the month ice seriously interfered with navigation in the harbors and bays of the Atlantic coast from Maine to North Carolina.

### TEMPERATURE.

In the Atlantic coast states from Massachusetts to northern Florida, in the Ohio Valley and the southern lake region, and at points in central and northern Illinois and northeastern Iowa the month was the coldest January on record. At stations in the middle and southern Rocky Mountain and plateau regions, and in southern California the month was the warmest January on record. A succession of severe cold waves visited the east Gulf and south Atlantic states. In Florida the cold waves of the 7th, 14th, and 17th caused considerable damage to fruit in the vicinity of Jupiter. On the 17th frost was reported as far south as the southern extremity of the "Everglades."

### PRECIPITATION.

Less than the usual amount of precipitation was reported, except in an area extending from the south Pacific coast to Montana and North Dakota, and over the northern lake region. From the middle and lower Mississippi rivers to the middle and southern Rocky Mountain regions, at stations in the north Pacific coast states and Tennessee, and at Albany, N. Y., the monthly precipitation was the least ever reported for January. At stations in the Red River of the North Valley and North Dakota the monthly precipitation was the greatest ever reported for January. In the middle and south Atlantic states, Arkansas, and north parts of the middle and west Gulf states the monthly snowfall was unusually heavy. In North Carolina and South Carolina the monthly snowfall averaged about 12.0 inches and 6.0 inches, respectively.

### STORMS.

Exceptionally severe gales prevailed over New England during the 1st and 2d. On the 5th and 6th heavy snow impeded railroad traffic in southern New England and the eastern parts of the middle Atlantic states, and destructive gales occurred along the middle Atlantic and New England coasts. From the 8th to the 10th a heavy snow and wind storm extended from the upper lake region over the middle Atlantic states. On the 12th heavy snow fell in the middle Atlantic states and along the south New England coast, and on the 13th snow fell over the interior of South Carolina. An exceptionally severe wind storm prevailed on the north Pacific coast during the 14th and 15th. A heavy snowstorm set in over Arkansas on the 17th and extended thence to the south Atlantic coast by the 18th. This snowstorm continued about two days, and was reported the severest ever experienced in the sections visited. A strong north gale, with heavy rain, thunder, and lightning, visited Key West, Fla., on the 24th. A destructive windstorm was reported at Heber, Utah, on the 30th. A severe storm of wind and snow, with very low temperature, occurred in the upper Missouri valley on the 31st.

## ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for January, 1893, as determined from observations taken daily at 8 a. m. and 8 p. m. (75th meridian time), is shown on Chart II by isobars.

The first of a series of charts showing the normal distribution of atmospheric pressure and prevailing winds over the United States and Canada for each month appears with this issue of the REVIEW. These charts exhibit normal pressure determined from Weather Bureau records for twenty years, and prevailing wind directions based upon records for fifteen years. The series will be completed with the publication in the Annual Summary for 1893 of a chart of annual normal pressure. The publication of these charts is preliminary to the publication by the Weather Bureau of specially

prepared data and charts showing meteorological and climatic features and conditions of the United States.

The normal distribution of pressure for January shows values above 30.20 in two areas, one of which covers the interior of the south Atlantic and east Gulf states and eastern Tennessee, and the other the middle and northern plateau and Rocky Mountain regions and the middle Missouri valley. Over adjoining parts of Idaho, Nevada, and Utah, the January normal is above 30.25. The lowest pressure for January is usually shown over the Canadian Maritime Provinces, where it is below 30.00. The normal values are below 30.05 on the extreme north Pacific coast.

In January, 1893, the mean pressure was highest over the middle plateau region, where it was above 30.30, and was lowest over the Canadian Maritime Provinces, where it was below 29.85.

The mean pressure was below the normal, except from the north Pacific coast over the plateau region and southern Texas. Over the Gulf of Saint Lawrence the mean readings were .20 below the normal, and the departure below the normal was .10 to .15 over the middle Atlantic and New England states, the eastern Ohio valley, and the eastern lake region. From the Rocky Mountains over the central valleys and the Southern States, and over extreme southern California the mean pressure was .05, or more, lower than usual. The departure above the normal pressure was .10 to .15 over the interior of Washington, and in an area covering the west part of the middle plateau region.

A comparison of the pressure chart for January, 1893, with that of the preceding month shows a decrease of pressure, except over the lower Saint Lawrence and eastern Saskatchewan valleys, and from the north Pacific coast over the plateau regions and the west Gulf states. The most marked decrease of pressure occurred over the southern lake region, upper Ohio valley, and middle Rocky Mountain region, where it was more than .10. The greatest increase of pressure was shown over the middle and northern plateau regions, where the mean readings were .05 to .09 higher than for December, 1892.

### HIGH AND LOW AREAS.

The paths of areas of high and low barometric pressure for January, 1893, are shown on Charts IV and I, respectively, and some of the more prominent features of the high and low areas are noted in the table at the end of this chapter.

### HIGH AREAS.

Twelve high areas appeared, the average number traced for January during the last 18 years being 9. Three of the high areas advanced from the Pacific, 7 from the Saskatchewan Valley, one from the middle plateau region, and one from the region north of Lake Superior. All of the high areas from the Pacific reached the middle or south Atlantic coasts, one disappearing over Florida, the others passing northeastward towards the Gulf of Saint Lawrence. Four of the high areas from the Saskatchewan Valley advanced to the Atlantic coast, 2 disappeared north of the Lake region, and one occupied the northeast slope of the Rocky Mountains at the close of the month. One of the high areas from the middle plateau disappeared by a decrease of pressure over the southeast slope of the Rocky Mountains, and the other disappeared over the south Atlantic states.

The high areas generally moved southeastward over the central valleys, and thence eastward to the Atlantic coast. In each instance the highest pressure was shown west of the 100th meridian. The average rate of advance of the high areas, 30 statute miles per hour, was somewhat greater than the average velocity of high areas for January. The following is a description of the high areas referred to:

I.—Appeared over the Saskatchewan Valley the evening of the 1st. On that date the temperature fell 20° to 30° north of North Dakota and eastern Montana, and at the evening report was —6° at Saint Vincent, Minn. During the 2d the high area moved slowly eastward to Manitoba, the temperature fell 20° to 30° from the Missouri Valley over the upper Mississippi valley and Lake Superior, the morning temperature at Saint Paul, Minn., was —6°, and the line of freezing weather reached Cairo, Ill. During the 3d this high area disappeared north of Lake Superior, a marked fall in temperature occurred in the middle Atlantic and New England states, the morning temperature at Springfield, Ill., was zero, and freezing weather was reported in Tennessee and northern Georgia in the evening. The morning of the 4th the line of freezing weather reached the Atlantic coast south of Wilmington, N. C.

II.—Appeared north of eastern Montana the evening of the 4th, with a temperature fall of 10° to 20° over eastern Montana and Assiniboia. During the 5th the high area passed southeastward over the Missouri Valley, attended by a fall in temperature of more than 20° in the Missouri Valley, and freezing weather to Tennessee. The morning of the 6th the high area occupied the middle Mississippi valley, the line of freezing weather reached the east Gulf coast, a reading of 12° was noted at Atlanta, Ga., and at Springfield, Ill., the temperature was —2°. By the morning of the 7th the high area occupied the south Atlantic states, the temperature was below freezing over the northern half of the Florida Peninsula, and frost was reported as far south as Jupiter, Fla.

III.—Moved northward over the northern Rocky Mountain region during the 6th, with a slight fall in temperature on the northeast slope. During the 7th the high area moved southeastward over the Missouri Valley, and the temperature fell more than 20° in Nebraska. Passing southward this high area disappeared by a decrease of pressure over the southeast slope of the Rocky Mountains on the 8th. On that date a cold wave overspread the middle and west Gulf states, and the line of freezing weather reached the interior of the Gulf States. The morning of the 9th the temperature was below freezing to the east Gulf coast, and a reading of 32° was reported at Jacksonville, Fla.

IV.—Appeared north of Montana the evening of the 8th, and during the 9th moved slowly eastward to Manitoba attended by a fall in temperature of 40° over southern Minnesota. By the evening of the 10th the high area had advanced to the lower Ohio valley, the temperature had fallen 20° to 30° in the middle Atlantic and west New England states, and the line of zero temperature reached Cincinnati, Ohio. During the 11th this high area passed off the North Carolina coast, the temperature fell below zero generally in New England, and the morning minimum was below freezing over interior and north parts of the Florida Peninsula.

V.—Appeared off the north Pacific coast the evening of the 10th. On that date the temperature fell 20° to 30° over Alberta. During the 11th the high area moved over the northern Rocky Mountain region, and the temperature fell 20° to 30° in the middle Rocky Mountain region. Passing southeastward over the Missouri Valley this high area was attended on the 12th by a cold wave which overspread the lower Missouri and middle Mississippi valleys, and carried the line of zero temperature to central Iowa. During the 13th this high area reached the east Gulf states, the cold wave reached the south Atlantic coast, and the evening temperature at Savannah, Ga., was 28°. During the 14th the high area settled southeastward over the Florida Peninsula; in the morning ice one-fourth inch in thickness was reported at Titusville, Fla., and oranges in exposed places were frozen. At Jupiter, Fla., heavy frost occurred, many plants were killed, but pineapples were not injured.

VI and VI*a*.—Advanced from the Pacific coast over British Columbia on the 13th, with a slight fall in temperature on the northeast slope of the Rocky Mountains. The evening of the 14th a ridge of high pressure extended from the British Northwest Territory to Texas, and the line of zero temperature reached Hannibal, Mo. During the 15th an area of high pressure of great magnitude occupied the central valleys, and covered districts thence to the Rocky Mountains. At the evening report higher pressure was shown north of the Dakotas, and over Wyoming, western Montana, Oklahoma, and northern Texas. On that date the cold wave overspread the middle Mississippi and Ohio valleys and the Southern States, the temperature fell to 10° below zero at Cincinnati, Ohio, and freezing weather was reported as far south as San Antonio, Tex.

During the 16th high area VI advanced southeastward to Iowa, and high area VI*a* moved eastward over the Gulf States, the temperature fell 20° to 30° in the middle and south Atlantic states, to 10° below zero at Knoxville, Tenn., and to 4° below zero at Lynchburg, Va., the line of freezing weather was carried to northern Florida, and the lowest temperature on record for January was reported at Atlantic City, N. J., and Augusta, Ga., where the minimum readings were 4° below and 12° above zero, respectively. On the 17th numbers VI and VI*a* united, and at the evening report the pressure was high from the Saint Lawrence Valley to the east Gulf coast.

The morning of the 17th the line of freezing weather reached Tampa and Titusville, Fla.; pineapples in exposed places were damaged about Jupiter, Fla., and frost was reported to the southern extremity of the "Everglades." At points in Virginia and North Carolina the lowest temperature on record for January was noted on the 17th. During the 18th this high area passed northeastward over the Canadian Maritime Provinces.

VII and VII*a*.—Moved southeastward over the northern Rocky Mountain region on the 16th and 17th, with a marked fall in temperature over Nevada, where a reading of 6° was registered at Winnemucca, Nev., the morning of the 17th. During the 18th the high area moved rapidly southeastward to Oklahoma, a cold wave overspread the upper Mississippi valley, the temperature fell to zero at Dubuque, Iowa, and the line of freezing weather reached Meridian, Miss. On the 19th this high area divided, one part passing to the lower Ohio valley and the other covering the Southwest, a severe cold wave extended over the lower Ohio valley, and the temperature fell to 4° below zero at Keokuk, Iowa. During the 20th the pressure continued high over the Southern States, a cold wave overspread the Gulf and south Atlantic states, the morning temperature at Mobile, Ala., was 22°, and a reading of 26° was reported at Charleston, S. C. During the 21st and 22d this high area moved slowly eastward, number VII passing off the middle Atlantic coast and number VII*a* disappearing off the south Atlantic coast.

VIII.—Appeared north of North Dakota the evening of the 22d, with a fall in temperature of 20° over North Dakota. During the 23d this high area moved eastward north of Lake Superior, where it disappeared by a decrease of pressure. On that date the temperature fell 20° to 30° over the valley of the Red River of the North and Lake Superior, and the morning temperature was below zero in western Minnesota.

IX.—Appeared over Alberta on the 24th, with pressure above 30.70 at the evening report, and a fall in temperature of 40° over Montana. The morning of the 25th the pressure had risen above 30.80 north of Montana. On that date a severe cold wave overspread the western Dakotas and western Nebraska, and the evening report showed temperature 24° below zero at Fort Buford, N. Dak., and zero at Huron, S. Dak. During the 26th the high area moved over the Red River of the North Valley, the temperature fell 20° to 30° from Lake Superior to Texas, the morning temperature was 30° below zero at Moorhead, Minn., and the line of zero temperature reached southern Iowa. Moving rapidly eastward this high area reached the Canadian Maritime Provinces on the 28th, its passage being attended on the 27th by a slight fall in temperature in the middle Atlantic and New England states.

X.—Appeared over Alberta the evening of the 27th, and was central over southern Alberta the morning of the 28th. On that date a general fall in temperature occurred from the middle plateau region over the Missouri Valley. During the 29th this high area advanced to the extreme upper Mississippi valley, a cold wave overspread the southern lake region, the Ohio and middle Mississippi valleys, and the Southwest, and the temperature fell to zero at Keokuk, Iowa. On the 30th the high area moved rapidly eastward to northern New England, and the night of the 30th apparently passed northward and united with high area XII. The morning reports of the 30th showed a fall in temperature of 20° over the lower lakes; over the Atlantic coast states the fall in temperature was slight.

XI.—Appeared over Alberta the evening of the 29th, with pressure above 30.80, and occupied the northeast slope of the Rocky Mountains during the 30th and 31st. On the 30th the weather was very cold over Montana and the Dakotas, and over North Dakota and Montana the temperature fell to 30° below zero. On the 31st the temperature fell 20° to 40° over South Dakota and Nebraska, and was 30° to 45° below zero in North Dakota and Montana. At Helena, Mont., the morning temperature of the 31st, 42° below zero, was the lowest ever noted at that station in January. In eastern Washington the temperature was 5° to 17° below zero on the 31st.

XII.—Advanced from the region north of Lake Superior to the lower Saint Lawrence valley during the last two days of the month. Following closely high area X, number XII produced slight temperature changes over the Northeastern States.

### LOW AREAS.

The average velocity of low areas for January and February, 37 statute miles per hour, is the highest noted for the year. The principal track of low areas for January is traced from the northeast slope of the Rocky Mountains over the upper lake region, the Saint Lawrence Valley, and Newfoundland. Less frequented tracks are traced from the middle plateau region and the west Gulf states to the Saint Lawrence Valley. About 2 low areas per month advance northeastward along the Atlantic coast in January. Four to five low areas traverse the Saint Lawrence Valley in January, making that the region of greatest storm frequency in North America. The average number of low areas which traverse the North American continent from the Pacific to the Atlantic coasts in January is about 2.

The tracks of 16 areas of low pressure are plotted on Chart I for January, 1893, the average number traced for January during the last 20 years being 13. Ten of the low areas first appeared over Alberta, one advanced from the north Pacific, one from the middle Pacific, and one from the south Pacific coasts, one moved southeastward from Wyoming, one originated north of Lake Superior, and one was a continuation of low area X for December, 1892. Six of the low areas from Alberta, and 2 of the low areas from the Pacific reached the Atlantic coast. The low area from the north Pacific coast occupied Lake Superior at the close of the month. The movement of the low areas was very erratic, and the average velocity varied from 16 to 54 miles per hour. Three of the low areas were attended by subsidiary developments, and 6 dissipated between the 80th and 100th meridians.

A notable characteristic of the low areas was the marked loss of strength shown while traversing the central valleys, and the decided increase in energy observed after they had

passed off the Atlantic coast. The unusually low temperature which prevailed over the central and eastern districts doubtless contributed to the loss of energy of the low areas in crossing those districts. The following is a description of the low areas traced:

I.—Was a continuation of low area X for December, 1892, and at the opening of the month was central over Kentucky, with pressure below 29.40. By the evening of the 1st the storm center had advanced to western Lake Ontario, the barometer had fallen below 29.10, a marked rise in temperature had occurred in the middle Atlantic and New England states, rain or snow was reported generally east of the Mississippi River, severe southeast gales set in over southern New England, and high south to southwest winds prevailed along the middle and south Atlantic coasts.

During the 2d the center passed to the northern part of the Gulf of Saint Lawrence, with pressure below 28.90, the temperature rose 20° to 30° in New England, the rain and snow area contracted over the Lake region, northern New York, and northern New England, and southerly winds of 50 to 60 miles per hour were noted on the Massachusetts coast in the morning.

II.—Occupied Alberta at the opening of the month, and at the evening report of the 1st was central over eastern Montana with pressure below 29.80, and snow over the greater part of the Dakotas and northeastern Montana. During the 2d this low area moved southeastward and disappeared by an increase of pressure over the middle Mississippi valley, attended by small areas of snow in the Missouri and middle Mississippi valleys.

III, III*a*, and III*b*.—Low area III was central over Alberta the morning of the 3d, with pressure below 29.40, and by the evening report had advanced to the region north of North Dakota. On that date the temperature rose 20° to 30° over the Dakotas, snow fell from North Dakota to the lower Ohio valley, and high southwest to northwest winds prevailed on the eastern slope of the Rocky Mountains. During the 4th this low area passed eastward to Lake Superior, a subsidiary development moved eastward over the Ohio Valley, and at the evening report a third disturbance appeared off the North Carolina coast. On that date snow fell generally from the middle and upper Mississippi and Red River of the North valleys to the middle Atlantic coast.

On the 5th low areas III and III*a* passed southeastward and united with the disturbance which moved northeastward from the North Carolina coast, and at 8 p. m. the pressure was below 29.40 off the middle Atlantic coast. On that date snow fell from the middle and upper Mississippi valleys to the middle Atlantic and south New England coasts, severe northeast gales prevailed along the middle Atlantic and New England coasts, and high northwest winds were reported over Lake Michigan.

During the 6th the storm center advanced to the vicinity of Cape Breton Island, where the barometer fell to 28.82, northeast shifting to northwest gales prevailed along the New Jersey and New England coasts, and heavy snow impeded railroad traffic in southern New England, eastern New York, eastern Pennsylvania, and New Jersey. High northwest winds continued along the New England coast until the morning of the 7th.

IV.—Appeared over Alberta on the 5th, with pressure below 29.80. During the 6th the center moved southeastward to the middle Missouri valley, the temperature rose 20° in the Missouri Valley, snow fell in the middle and upper Missouri and upper Mississippi valleys, and high northwest winds prevailed over the Dakotas and Nebraska. Passing southeastward this low area disappeared by an increase of pressure over the east Gulf states the night of the 7th. On that date the snow area overspread the Lake region, the Ohio and middle Mississippi valleys, and the interior of the middle Atlantic states.

V.—Appeared over northern Alberta on the 7th, passed thence to Lake Superior by the evening of the 8th, and reached eastern Ontario by the night of the 9th. On the 8th the temperature rose 20° to 30° in the Missouri Valley, and snow fell in the Lake region, the upper Ohio valley, and the interior of the middle Atlantic states. On the 9th the temperature rose 20° to 30° in eastern Ontario, the snow area extended to the middle Atlantic and New England coasts, and heavy, drifted snow interrupted traffic in Upper Michigan and northern Lower Michigan.

The morning of the 10th the low area was central off the Maine coast, with pressure about 29.00, and by the evening report of that date had advanced to the lower Saint Lawrence valley, where the barometer fell to 28.88 at Father Point, Quebec. On that date the temperature rose 30° in the Canadian Maritime Provinces, high northwest winds prevailed along the middle and north Atlantic coasts, and drifted snow interfered with railroad traffic in Pennsylvania. By the morning of the 11th the storm center had disappeared north of the Gulf of Saint Lawrence.

VI and VI*a*.—Appeared north of western Montana on the 9th. The morning of the 10th this low area divided, one part passing to South Dakota and the other to the region north of North Dakota. On that date snow fell in the middle and upper Missouri valleys, and high westerly winds prevailed in the middle Rocky Mountain region. During the 11th a trough of low pressure moved eastward over the central valleys and the Lake region, snow fell generally north of the Ohio and Missouri rivers, heavy snow was general in northern Illinois, and high northwesterly winds prevailed in the Missouri Valley. By the night of the 12th low areas VI and VI*a* had united off the south New England coast. On that date heavy snow fell in the middle Atlantic states and on the south New England coast.

VII.—Appeared over northern Alberta the evening of the 12th, and during the 13th moved rapidly southeastward to the middle-eastern slope of the Rocky Mountains, with pressure below 29.80, snow in the middle and upper Missouri valleys, and high westerly winds in the middle Rocky Mountain region. The evening of the 14th this low area presented a trough of low pressure extending from the lower lakes to the middle Gulf coast, the snow area had extended to the middle Atlantic coast, and heavy snow had interrupted traffic and telegraphic communication in the middle and upper Ohio valleys. During the 15th this low area passed eastward off the middle Atlantic coast and thence northeastward towards Nova Scotia.

VIII.—Occupied the upper Saskatchewan valley the morning of the 16th, and by the evening report had advanced to Manitoba, with pressure below 29.80. During the 17th the storm-center advanced to Lake Superior, and snow fell from the Dakotas over the upper lake region. Moving slowly over the upper lakes during the 18th this low area apparently dissipated over New England the early part of the 19th. Its passage over the Great Lakes was unattended by noteworthy features.

IX.—Appeared over the lower Colorado valley the evening of the 16th, with rain in southern California and southern Arizona, and snow in Colorado and northern New Mexico. During the 17th the center of disturbance moved rapidly eastward to the lower Rio Grande valley, snow or rain fell generally in the Southwest, and exceptionally heavy snow set in over Arkansas in the evening. On the 18th the storm-center advanced to the middle Gulf coast, the rain and snow area extended from the Gulf and south Atlantic coasts over the Lake region, and heavy rain, changing at night to heavy snow, fell over the Gulf States. By the morning of the 19th

this low area had passed off the south Atlantic coast, the area of heavy rain and heavy snow had extended over the south Atlantic states, and northerly gales prevailed on the Carolina coast.

X.—Was an area of low pressure of slight intensity which moved eastward over the upper Saskatchewan valley during the 18th and 19th. This low area was attended by light snow from Manitoba to northwestern Wisconsin on the 19th.

XI.—Appeared over northern Alberta the evening of the 19th, with pressure below 29.80, and passed thence to Manitoba by the night of the 20th, with a rise in temperature of 20° to 30° in Iowa, and light snow in the upper Mississippi valley and the western lake region. The night of the 20th this low area disappeared north of Lake Superior. During the 21st the snow area extended eastward over the Lake region and the middle Ohio valley.

XII.—Was probably a continuation of low area XI, and moved slowly eastward over the northern lake region during the 22d and 23d, attended by light snow, which extended over the middle Atlantic and New England states during the 23d. During the 24th this low area dissipated north of Lake Ontario.

XIII.—Moved southeastward from Alberta and the evening of the 23d occupied North Dakota, with pressure below 29.80. On that date light snow fell over the eastern Dakotas and in the valley of the Red River of the North. During the 24th the low area moved to southwestern Lower Michigan, and the snow area extended over the Lake region, the Ohio Valley, and parts of New York and Pennsylvania. During the 25th the center of disturbance moved rapidly eastward and at the evening report was central near Eastport, Me. On that date the snow area contracted over northern New England and northern New York. By the morning of the 26th the storm center had passed east of Nova Scotia.

XIV.—Was a short-lived low area of slight intensity which moved southeastward over the Rocky Mountain region from Montana to northwest Texas during the 24th and 25th. On the 24th snow fell on the northeast slope of the Rocky Mountains, and in parts of the Dakotas. On the 25th the snow area covered the middle and upper Missouri and extreme upper Mississippi valleys.

XV.—The presence of a disturbance off the middle Pacific coast was shown by reports of the 25th, and the morning of the 26th this low area was apparently central near Eureka, Cal., where the pressure was 29.48. During the day the pressure decreased to 29.24 at Eureka, heavy rain fell in central and northern California, snow was reported over the northern Rocky Mountain and plateau regions, and hard easterly gales prevailed on the north Pacific coast. During the 27th this low area apparently divided, one part, low area XV, passing to the middle Rocky Mountain region and the other to the north Pacific coast. On that date heavy rain fell in California, snow was reported generally over the north part of the middle plateau, and from the north Pacific coast over the northern Rocky Mountain region, and high south to west winds prevailed over the middle plateau and middle and southern Rocky Mountain regions.

During the 28th the storm-center advanced to Illinois, with pressure below 29.70. East of the Mississippi River rain fell in areas. Between the Mississippi River and the Rocky Mountains snow was followed by clearing, colder weather, and high westerly winds prevailed over the Western States. Moving rapidly northeastward the center reached the region north of the lower Saint Lawrence river the night of the 29th. On that date westerly gales prevailed over the Great Lakes, heavy rain fell in the middle Atlantic and New England states, and snow drifted heavily in eastern Upper Michigan.

XVI.—As noted in the description of low area XV the area of low pressure which appeared on the middle Pacific coast on the 25th divided on the 27th, one part, number XV, pass-

*Tabulated statement showing principal characteristics of areas of high and low pressure.*

| Barometer. | First observed. | | | Last observed. | | Duration. | Velocity per hour. | Maximum pressure change in 12 hours, maximum abnormal temperature change in 12 hours, and maximum wind velocity. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Date. | Lat. N. | Long. W. | Lat. N. | Long. W. | | | Station. | Rise. | Date. | Station. | Fall. | Date. | Station. | Direction. | Miles per hour. | Date. |
| High areas. | | ° | ° | ° | ° | *Days.* | *Miles.* | | *Inch.* | | | ° | | | | | |
| I | 1 | 53 | 104 | 48 | 87 | 1.5 | 22 | Concordia, Kans | .40 | 2 | Moorhead, Minn | 30 | 1 | Springfield, Ill | nw. | 28 | 3 |
| II | 4 | 51 | 106 | 34 | 83 | 2.0 | 39 | Swift Current, N. W. T. | .56 | 4 | Bismarck, N. Dak | 28 | 5 | Kansas City, Mo | nw. | 36 | 5 |
| III | 5 | 42 | 113 | 31 | 101 | 2.5 | 43 | Qu'Appelle, N. W. T | .70 | 6 | Springfield, Mo | 24 | 7 | Rapid City, S. Dak | nw. | 42 | 7 |
| IV | 8 | 54 | 110 | 38 | 82 | 2.5 | 34 | Duluth, Minn | .46 | 9 | Kingston, Ont | 34 | 10 | Hatteras, N. C | nw. | 36 | 11 |
| V | 10 | 45 | 125 | 28 | 82 | 4.0 | 33 | Swift Current, N. W. T. | .56 | 11 | Bismarck, N. Dak | 30 | 11 | Kearney, Nebr | n. | 46 | 12 |
| VI | 13 | 51 | 121 | 48 | 65 | 5.0 | 30 | Rapid City, S. Dak | .56 | 14 | Calgary, N. W. T | 28 | 13 | Block Island, R. I | ne. | 36 | 18 |
| VIa | 15 | 41 | 105 | 32 | 83 | 1.5 | 42 | Springfield, Mo | .58 | 14 | San Antonio, Tex | 22 | 15 | Titusville, Fla | n. | 30 | 17 |
| VII | 16 | 50 | 120 | 39 | 72 | 6.0 | 24 | El Paso, Tex | .32 | 18 | Bismarck, N. Dak | 26 | 17 | Pueblo, Colo | n. | 32 | 17 |
| VIIa | 19 | 35 | 97 | 30 | 78 | 3.5 | 19 | Hatteras, N. C | .24 | 20 | Abilene, Tex | 14 | 18 | Titusville, Fla | n. | 18 | 21 |
| VIII | 22 | 52 | 100 | 50 | 87 | 1.0 | 25 | Prince Albert, N. W. T. | .32 | 22 | Minnedosa, Man | 25 | 22 | Winnipeg, Man | ne. | 18 | 22 |
| IX | 25 | 53 | 113 | 43 | 62 | 4.0 | 28 | Rockliffe, Ont | .56 | 27 | Helena, Mont | 39 | 24 | Fort Buford, N. Dak | nw. | 28 | 25 |
| X | 28 | 52 | 113 | 43 | 73 | 2.5 | 35 | Alpena, Mich | .64 | 29 | do | 35 | 27 | Buffalo, N. Y | sw. | 36 | 30 |
| XI | 30 | 53 | 114 | 48 | 110 | 1.0 | 17 | Pierre, S. Dak | .80 | 31 | Huron, S. Dak | 43 | 31 | Fort Buford, N. Dak | nw. | 42 | 31 |
| XII | 30 | 51 | 87 | 47 | 72 | 1.0 | 30 | Port Arthur, Ont | .32 | 30 | Milwaukee, Wis | 14 | 30 | Father Point, Que | n. | 24 | 31 |
| Mean | | | | | | 2.7 | 30 | | .50 | | | 28 | | | | 32 | |
| Low areas. | | | | | | | | | Fall. | | | Rise. | | | | | |
| I | 1 | 38 | 84 | 47 | 71 | 1.0 | 40 | Kingston, Ont | .76 | 1 | Chatham, N. B | 28 | 2 | Woods Holl, Mass | se. | 60 | 2 |
| II | 1 | 53 | 113 | 39 | 97 | 1.0 | 54 | Miles City, Mont | .30 | 1 | Moorhead, Minn | 18 | 1 | Cheyenne, Wyo * | w. | 38 | 1 |
| III | 3 | 53 | 115 | 45 | 60 | 3.5 | 28 | Edmonton, N. W. T | .60 | 2 | Valentine, Nebr | 23 | 3 | Havre, Mont | sw. | 52 | 3 |
| IIIa | 4 | 39 | 90 | 36 | 75 | 1.0 | 38 | Kansas City, Mo | .44 | 3 | Cairo, Ill | 21 | 4 | Block Island, R. I | ne. | 70 | 6 |
| IV | 5 | 52 | 114 | 34 | 87 | 2.0 | 40 | Bismarck, N. Dak | .54 | 6 | Rapid City, S. Dak | 24 | 6 | Kearney, Nebr | nw. | 54 | 6 |
| V | 7 | 54 | 113 | 50 | 65 | 3.5 | 33 | Saint Vincent, Minn | .78 | 8 | Saint Paul, Minn | 36 | 8 | Woods Holl, Mass | nw. | 51 | 10 |
| VI | 9 | 51 | 114 | 40 | 67 | 3.0 | 35 | Prince Albert, N. W. T. | .50 | 10 | Rockliffe, Ont | 27 | 12 | Bismarck, N. Dak | n. | 52 | 11 |
| VIa | 10 | 48 | 110 | 40 | 67 | 2.5 | 50 | Hatteras, N. C | .50 | 12 | Wilmington, N. C | 24 | 12 | Kearney, Nebr † | nw. | 54 | 11 |
| VII | 12 | 53 | 112 | 42 | 65 | 3.0 | 50 | Halifax, N. S | .44 | 15 | Atlanta, Ga | 26 | 14 | Colorado Springs, Colo ‡ | nw. | 51 | 13 |
| VIII | 16 | 54 | 108 | 45 | 80 | 3.0 | 21 | Minnedosa, Man | .62 | 16 | Keokuk, Iowa | 30 | 17 | Saint Vincent, Minn | s. | 36 | 17 |
| IX | 16 | 34 | 115 | 33 | 75 | 2.5 | 45 | Hatteras, N. C | .54 | 19 | New Orleans, La | 13 | 18 | Kittyhawk, N. C | ne. | 52 | 19 |
| X | 17 | 55 | 114 | 53 | 100 | 1.5 | 16 | Medicine Hat, N. W. T. | .26 | 17 | Moorhead, Minn | 24 | 19 | Bismarck, N. Dak | nw. | 28 | 19 |
| XI | 19 | 53 | 115 | 51 | 100 | 1.0 | 27 | Calgary, N. W. T | .32 | 19 | Medicine Hat, N. W. T | 15 | 20 | Havre, Mont | sw. | 28 | 20 |
| XII | 22 | 48 | 87 | 47 | 80 | 1.0 | 14 | White River, Ont | .20 | 21 | Knoxville, Tenn | 22 | 22 | Marquette, Mich | nw. | 16 | 23 |
| XIII | 23 | 51 | 112 | 45 | 66 | 2.5 | 42 | Sydney, C. B. I | .56 | 26 | Indianapolis, Ind | 26 | 24 | Cleveland, Ohio | nw. | 40 | 25 |
| XIV | 24 | 44 | 108 | 36 | 102 | 1.0 | 25 | Salt Lake City, Utah | .24 | 24 | Fort Smith, Ark | 16 | 25 | Amarillo, Tex | sw. | 36 | 25 |
| XV | 26 | 41 | 125 | 48 | 70 | 3.5 | 42 | Sydney, C. B. I | .58 | 30 | Kingston, Ont | 30 | 29 | Tatoosh Island, Wash § | se. | 72 | 26 |
| XVI | 29 | 48 | 125 | 48 | 90 | 2.0 | 42 | Moorhead, Minn | .76 | 31 | Moorhead, Minn | 38 | 31 | Huron, S. Dak | w. | 60 | 31 |
| XVIa | 30 | 43 | 110 | 38 | 104 | 1.0 | | | | | | | | | | | |
| Mean | | | | | | 2.1 | 36 | | .50 | | | 24 | | | | 47 | |

*80 miles nw., Pikes Peak, Colo., 1st. †98 miles w., Pikes Peak, Colo., 10th. ‡96 miles w., Pikes Peak, Colo., 13th. §96 miles w., Pikes Peak, Colo., 27th.

ing over the middle plateau. The other part apparently moved northward and occupied the north Pacific coast until the morning of the 30th, attended by snow and gales in Washington and Oregon. The evening report of the 30th showed a trough of low pressure extending from the north Pacific coast to the middle Rocky Mountain region. On that date a disturbance appeared on the middle California coast, heavy rain prevailed in California, heavy snow fell in areas from the north Pacific coast over the middle plateau, destructive windstorms were reported in Utah, and west to northwest gales occurred on the Washington coast.

By the morning of the 31st this low area had been divided by an area of high barometer (number XI) which extended rapidly southeastward over the eastern Rocky Mountain slope. One part, XVI, occupied eastern Nebraska and the other, XVI*a*, was central over Colorado. By the evening report of the 31st XVI had advanced to Lake Superior, and XVI*a* remained over Colorado. On that date rain fell in the Ohio and middle Mississippi valleys and the southern lake region, a heavy snowstorm prevailed in Minnesota and parts of Iowa, and snow was followed by clearing weather, high westerly winds, and intense cold in the Northwest.

## NORTH ATLANTIC STORMS FOR JANUARY, 1893.

[*Pressure in inches and millimeters; wind-force by Beaufort scale.*]

The paths of storms that appeared over the west part of the north Atlantic Ocean during January, 1893, are shown on Chart I. These paths have been determined from reports of observations by shipmasters received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

The normal distribution of pressure over the north Atlantic Ocean for January shows highest pressure in a small area situated about midway between the Azores and the Windward Islands, where the values are above 30.20 (767). A belt of high pressure, with readings above 30.10 (764), stretches from the eastern part of the ocean between the 20th and 40th parallels to the coast of the United States south of the 41st parallel. The normal pressure is lowest in an elongated area extending from southern Greenland over Spitzbergen, where it is below 29.50 (749).

In January there is usually an increase of pressure over the southern part of the north Atlantic Ocean, the greatest increase, about .05 inch, appearing in an area southwest of the Azores. Over the northern part of the ocean there is a decrease of pressure. The storms of January generally advance from the Canadian Maritime Provinces towards the Iceland area of low pressure. The storms of this month have an average velocity of about 22 statute miles per hour, and an average of about 2.5 storms per month traverse the ocean from the American to the European coasts.

Generally fine weather prevailed in the vicinity of the British Isles during January, 1893. In the first decade a storm apparently moved eastward over the Bay of Biscay, and from the 24th to the close of the month the pressure continued low west of Ireland. Over mid-ocean and thence to the American coast the month was marked by storms of exceptional severity. Three storms were traced from American to European waters.

Two storms of marked strength occupied the north Atlantic at the opening of the month. One of the storms was central southwest of Ireland, with pressure below 29.30 (744), the other was located southwest of the Azores, where the barometer fell to about 29.40 (747). The afternoon and evening of the 1st westerly gales prevailed along the middle and south Atlantic coasts, attending the passage of low area I over the lower lake region. During the 2d the pressure continued low west of the British Isles, and a severe storm moved northeastward over the Azores. Low area I passed northeastward over the lower Saint Lawrence valley and the north part of the Gulf of Saint Lawrence, and hard westerly gales continued along the Atlantic coast.

Reports of the 3d indicate that the storm central west of the British Isles on the 1st and 2d united with the storm which advanced from the Azores. On that date hard gales and pressure below 29.30 (744) were reported between the 20th and 30th meridians and south of the 50th parallel, and the pressure continued low over the Gulf of Saint Lawrence. During the 4th the pressure continued low over mid-ocean and the Gulf of Saint Lawrence.

On the 5th low area III advanced off the middle Atlantic coast, with pressure about 29.40 (747), and the pressure continued low between the 20th and 30th meridians. During the 6th low area III moved northeastward to a point south of Cape Breton Island, with pressure below 29.00 (736), and west to northwest gales of force 10 to 11 were encountered between the 55th and 65th meridians. The pressure continued low southwest of the British Isles. The morning of the 7th low area III was central south of Newfoundland, with pressure about 29.15 (740), and the storm over the eastern part of the ocean had increased in energy and shifted position to a point southwest of Ireland.

During the 8th low area III advanced to mid-ocean, and the pressure was about 29.30 (744) south of Ireland. By the 9th low area III had advanced to a position north of the Azores, with central pressure below 29.40 (747), the storm which had occupied the ocean southwest and south of the British Isles from the 6th to the 8th had moved eastward over the Bay of Biscay, and a storm area covered Newfoundland and the Grand Banks. By the morning of the 10th low area III had apparently moved eastward over the Bay of Biscay, a storm from the Grand Banks had moved northeastward north of the 50th parallel, low area V had advanced off the New England coast, with pressure below 29.10 (739), and westerly gales of force 9 to 11 were reported west of the 60th meridian. During the 10th low area V recurved northward to the lower Saint Lawrence valley and passed thence northeast of Newfoundland by the 12th, attended by strong gales over and near the Grand Banks.

During the 12th low area VI passed south of east off the New England coast, with pressure about 29.30 (744) and northwest to west gales of force 10. Moving northeastward, with gales of force 9 to 11, low area VI reached a position east of Cape Breton Island the morning of the 13th, and disappeared north of Newfoundland during the 14th. On the 15th low area VII moved northeastward off the New England and Nova Scotia coasts, and a storm appeared south of the Azores. During the 16th low area VII disappeared north of Newfoundland, and the storm south of the Azores increased in energy. During the 17th and 18th the storm near the Azores shifted position to the west and northwest, and by the 19th had apparently reached Newfoundland, attended by northwest gales of force 7 to 10 west of the 60th meridian.

The morning of the 19th low area IX passed off the south Atlantic coast, attended by severe gales south of Hatteras. During the 20th low area IX moved northeastward to the Grand Banks, with northwest gales of force 9 to 10 off the Atlantic coast, and passed northeast of Newfoundland by the